Valor 6800

DIABLO

PAGES

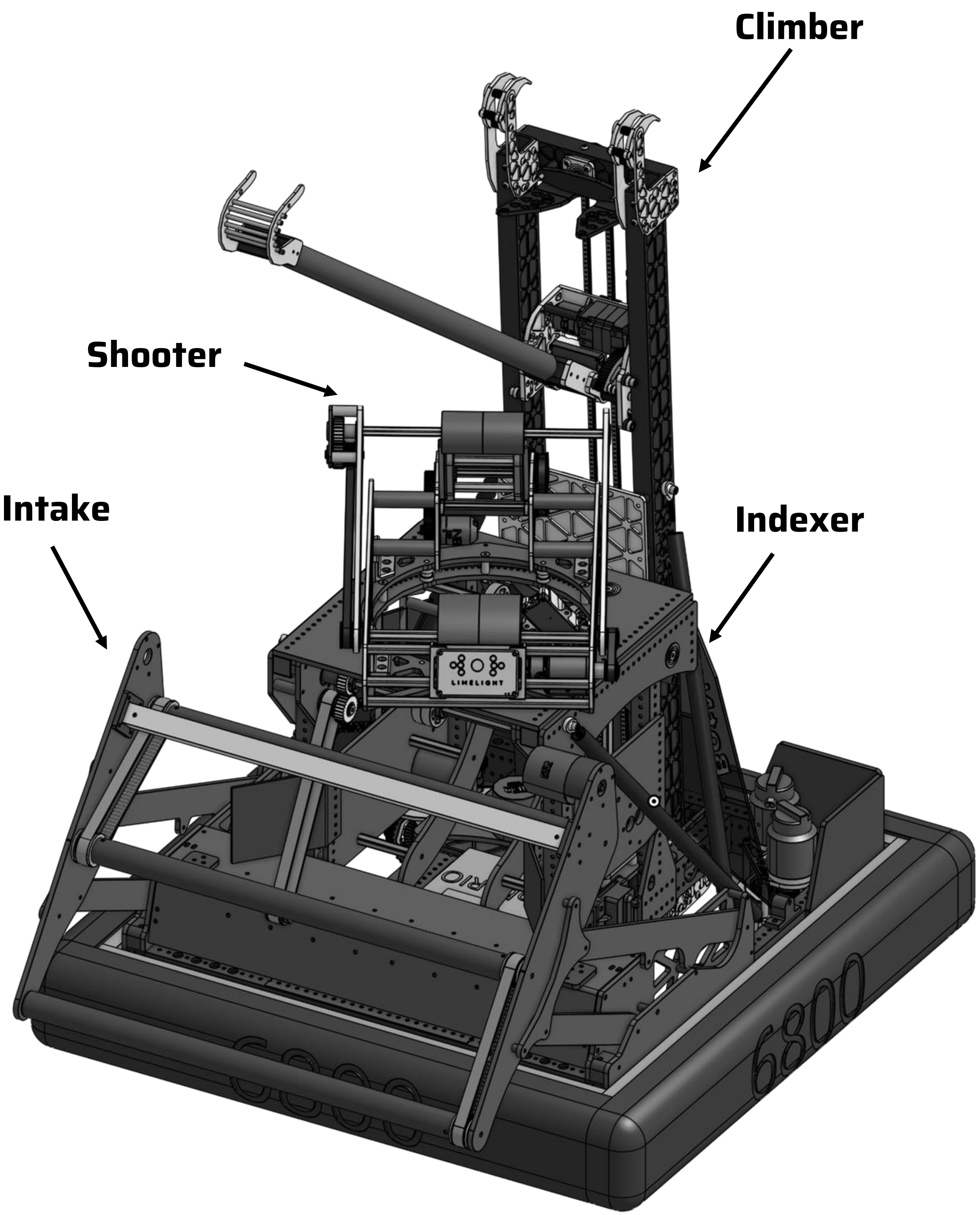
STRATEGY

After analyzing scoring data, we were able to base our design off of how to earn the most points:

- ➢ A 22 point Auto
- ➢ A swerve drivetrain for quickest cycle time
- ➢ A shooter with pinpoint accuracy
- ➢ A climber that can reach the traversal

NEED	WANT	WISH
Move fast	Score cargo lower	Collect from terminal
Withstand 'big bonks'	Score anywhere	Block Shots
Collect from ground	Traversal	Accommodate other robots on hangar
Hold 2 cargo	Play Defense	
Score cargo upper	Collect outside frame	
Score from tarmac	Touch-it Own-it	
Low/Mid/High	Shoot quick	
Extend outside frame perimeter		
Limelight tracking		
Navigate Terrain		
Move omnidirectionally		
Low CG		

VALOR 6800



OVERALL DESIGN

Six separate subsystems that all work as one to create the best possible design for this game.

Chassis

- **Move in any direction.** - We chose to go with a swerve drive this year, given that this game is especially reliant on making as many cycles as possible and avoiding other robots.
- **Quick!** - Swerve drive has many uses in this game, and quick movement plays back into our goal of making as many cycles as possible while avoiding other robots.

Intake

- **Touch it Own it Mentality.** - With our sturdy but light design, the second our robot comes in contact with a cargo, it is quickly sent through the intake and into the indexer. With our intake design, we can also hold up to 2 cargo between the rollers and the chassis, meaning we can shoot 1 cargo at a time if needed, and have extra space inside our robot.
- **Can take a hit!** - Thanks to our Four-Bar Deployment, the intake can be shaken from side to side or hit (where it folds back into our robot) without taking any substantial damage. This comes into use while hanging, as the intake can work as an extra layer of protection for our robot.

Indexer

- **Fast paced.** - Due to the curved structure that moves cargo diagonally upwards, and the fact that cargo is in contact with moving components of the indexer/intake at all times, we have been able to eliminate dead zones; we can quickly propel the cargo along its path.
- **Compact design.** - With an aluminum box tube and custom polycarbonate structure, the indexer is rigid and maintains compression on the cargo. Additionally, the indexing superstructure is made as small as possible but storing one cargo completely inside the structure and another partially over the intake.

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Shooter

- **Adjustable Hood.** - Smooth and swift adjustment allows us to maximize shot capability with a continuously variable shot mechanism. The hood has variety in the launch angle and the launch speed. A compact design enables easy turret tracking and adjustment.
- **Precise angle and accuracy.** - The gear provides a 13 degree range of motion and the shooter's direct contact with the cargo increases our accuracy percentage. Limelight tracking allows our shooter to snap to the target within a 60-degree window

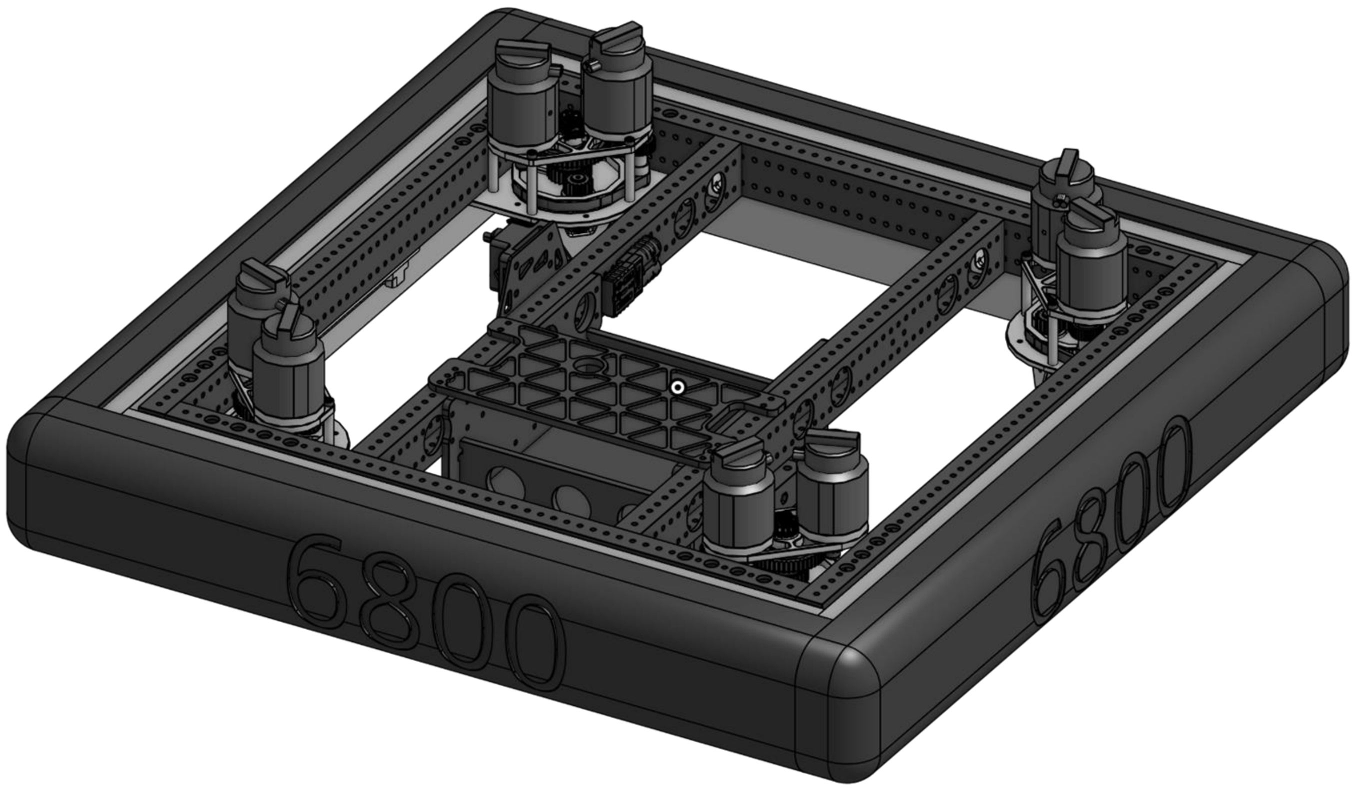
Climber

- **Dynamic range of motion.** - A vertical extension, and 2 static arms that help with secure attachment. The dynamic range of motion allows us to travel all the way to the traversal rung. We are able to go under the bottom rung and begin the lift on the second rung to avoid the complication of lifting on a rotating rung.
- **Sturdy and strong.** - Thanks to a sturdy design consisting of a round tube and isogrid pocketed 1x2 bars, we are able to cut weight while maintaining a sturdy design.

Programming

- **Field centric and path following.** - Our robot is programmed with the driver capability of moving in any direction at any point of time. Drivers can change rotational velocity independently of translational velocity. Our robot follows a motion profile specifying velocity and acceleration at every time in the robot's motion. The robot moves in smooth spline curves throughout auto, achieving accurate and efficient movement.
- **Substem class structure and control.** - With each subsystem inheriting a parent class, defining standard operational methods common to all the subsystems, we can treat each subsystem as the same class type. This eliminates the potential for forgotten initialization and common bugs.

CHASSIS



Small and simple

- ➢ 26”x26” square chassis
- ➢ 2”x1” box tube of 1/8” wall
- ➢ 1.25” ground clearance to bumper

Electronics

- ➢ Battery mounted below the chassis rails to keep center-of-gravity as low as possible
- ➢ Foam battery cage protects the battery from rattling around while driving
- ➢ Grommet holes strategically placed for easy wire routing
- ➢ Mirrored electronic mounting holes for flexibility in component placement

Swerve Drive

- ➢ 4 MK4 swerve modules (details in following section)
- ➢ Protector panels (not shown) prevent game elements or robots from interfering with each module

DRIVETRAIN

Module Information

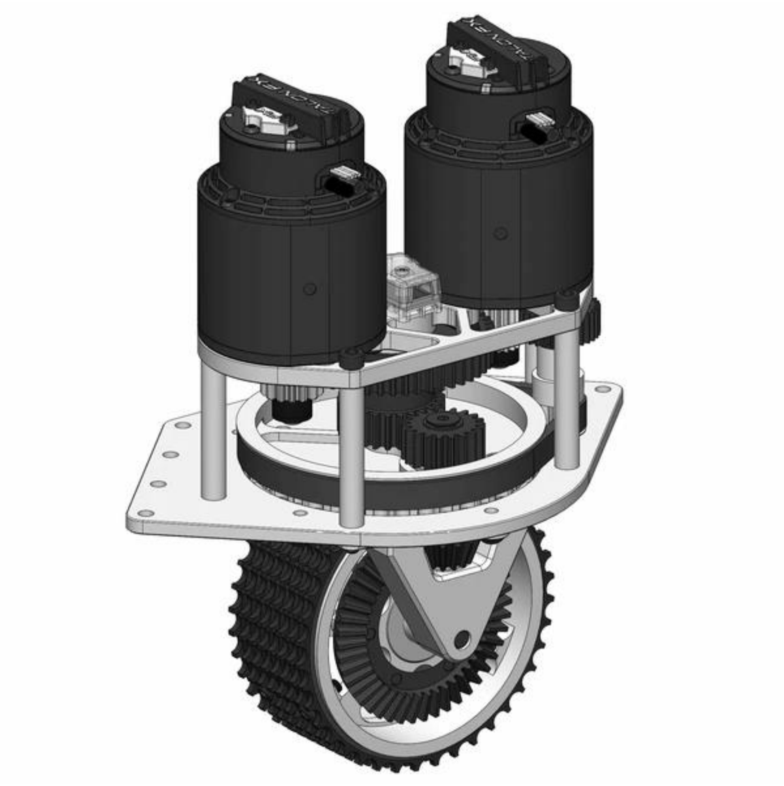
- SwerveDriveSpecialties (SDS) MK4 modules
- L4 option – 5.14:1 gear ratio
- Free speed of 21 feet-per-second
- 21lbs for all 4 swerve modules

Motors and Sensors

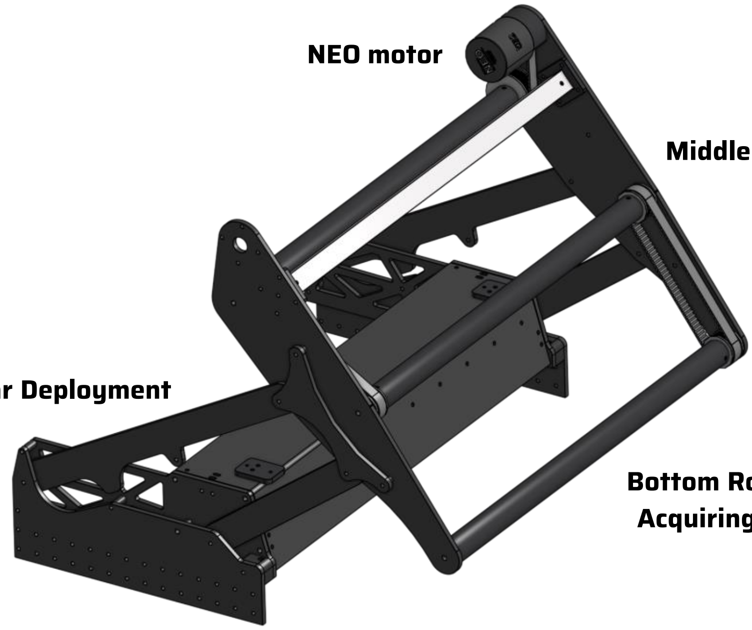
- Azimuth rotation controlled by a Falcon 500 motor
- Drive wheel controlled by a Falcon 500 motor
- Wheel orientation measured by a CTRE SRX Mag Encoder

Robot Optimization

- The four independent modules take up small volumes, which allow for the optimum design of other subsystem mechanisms
- The simplicity of this COTS module and the ease of making the rest of the chassis allows the team to focus more time and effort on other robot subsystems.



INTAKE



Immediate and consistent control with a sturdy but light design. The intake utilizes three tread-covered VersaTube rollers to compress the cargo, creating a smooth intake process with traction that guides the cargo towards the indexer. It is attached with a polycarbonate four-bar linkage so that when the bottom roller rotates, the intake deploys. Our intake sizing enable us to utilize the bumpers as extra compression and guides for the cargo.

Rollers for Acquiring Cargo

- 1.25 in x 24.5 in VersaTube is lighter and sturdier while still accounting for compression.
- 7.3 in gap from the ground to the bottom roller
- The bottom roller allows us to implement a “touch-it-own-it” strategy with our nitrile wheel tread design
- Polycarbonate panels guide the cargo into the indexer

Powering the intake

- A single NEO 550 powers the top roller, with the middle/bottom rollers belt driven off the top
- The intake roller spins with a 2:1 gear ratio

Deployment

- Two intake tensioning bands attach from the intake to the chassis, allowing our intake to snap down when the bottom roller spins at the start of a match
- No pneumatics or motors for deployment which saves space and weight

INDEXER

To minimize the amount of time it takes for cargo to be moved from the intake to the shooter, cargo is held in contact with moving components of the intake and index at all times, eliminating the chance that cargo could hit a “dead zone”. We utilize a curved structure that moves cargo diagonally upwards for maximum efficiency.

Superstructure

- ➢ Overall frame is comprised of four vertical 1x1 box tubes
- ➢ Polycarbonate bent at 140 degrees and mounted on both sides funnels cargo into the indexer.
- ➢ On the bottom of the frame are custom polycarbonate plates for easy mounting to the chassis.

Motor and belt

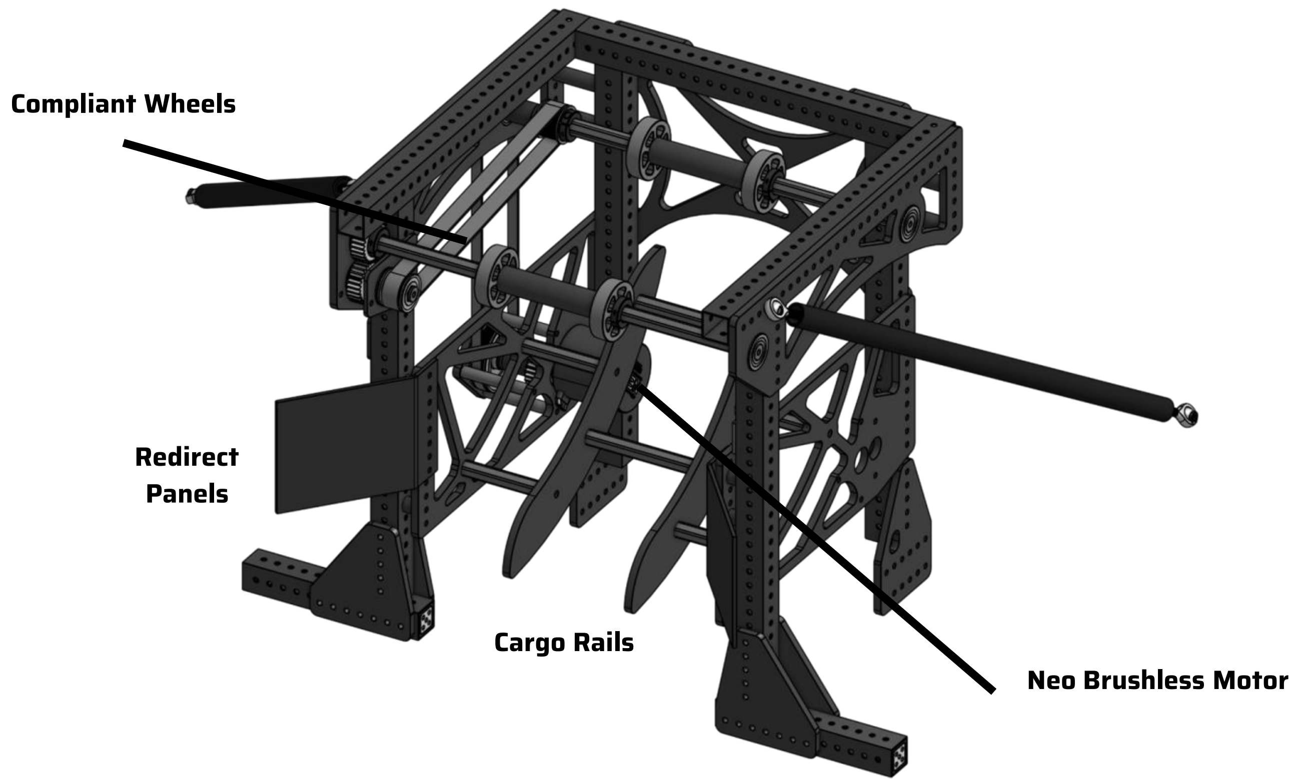
- ➢ The indexer is powered by one NEO brushless motor geared to 9:26 to increase torque.
- ➢ Two axles are used to position the complaint wheels and are connected via belt with a 1:1 ratio.

Cargo Rails

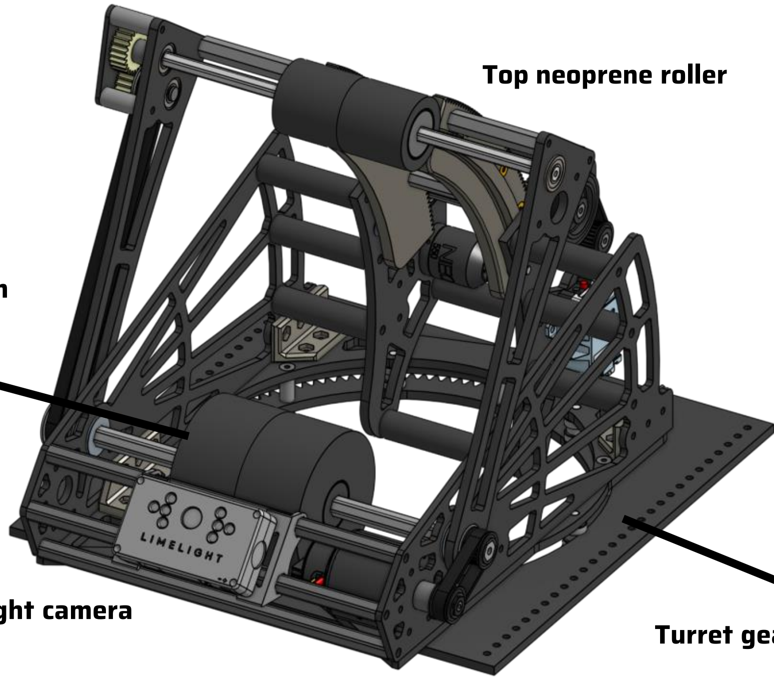
- ➢ Curved polycarbonate rails that measure roughly 12 inches from end to end are designed to maintain a consistent compression on cargo.
- ➢ A small layer of foam on the rails slightly increases compression and ensures that cargo is not damaged while passing through the indexer.

Compliant Wheels

- ➢ 2 inch rubber wheels, powered by the motor, are used to move the cargo through the indexer



SHOOTER



With an adjustable hood that is automatically set by the area the robot shoots from and the ability to rotate 180 degrees, the shooter can score anywhere from the tarmac to the side walls. The shooter also aims to shoot into the Upper Hub, by having a precise angle set via a hood, and maintains an accurate view of the hubs via Limelight tracking.

Turret

- Powered by a 60:1 reduction with a NEO motor
- Final stage of the gear reduction is run through a custom-routed 120 tooth 10 DP gear
- 11” bore in the middle for cargo to pass through from the feeder into the flywheel of the shooter.
- We created bearing stack-ups held together by press-fit ¼” dowels, securely holding the upper shooter in place, while still allowing for smooth rotation for the turret mechanism.

Flywheel

- The primary flywheel is powered by one Falcon 500 with a 1:1 belt-driven reduction.
- The large bottom flywheel is a 4” Diameter 35A durometer neoprene roller
- To reduce backspin, we included a 2” diameter top roller belted from the main axle at a 1:1 gear ratio

Hood

- The hood mechanism is powered by 1 neo 550 motor, geared to a total reduction of 454:1.
- The hood travel operates through a custom-markforged sector gear, with the pitch diameter equivalent to a 436 tooth 20 DP gear.
- The sector gear provides the shooter with a 13 degree range of motion, and directly makes contact with the cargo as it travels up through the shooter system during a shot.

CLIMBER

The climber has 2 stages, with 2 vertical tubes with a carriage that runs between. This carriage contains a powered pivot that rotates a “dynamic stage” to grab the next rung.

Design Constraints

- ➢ Can extend to 75” above the ground
- ➢ The “Dynamic stage” can pivot to 45 degrees
- ➢ Horizontal reach of 11” off the front chassis rail.

Extension Gearbox

- ➢ The extension/retraction is powered by 2 Falcon 500s
- ➢ 6.25:1 single reduction gearbox.
- ➢ Loaded with 120 lbs it retracts in <1 second
- ➢ Falcons are cleverly located just 1.25” off the ground to keep the CG as low as possible
- ➢ The power is transmitted to the carriage through a #25H chain

Dynamic Arm

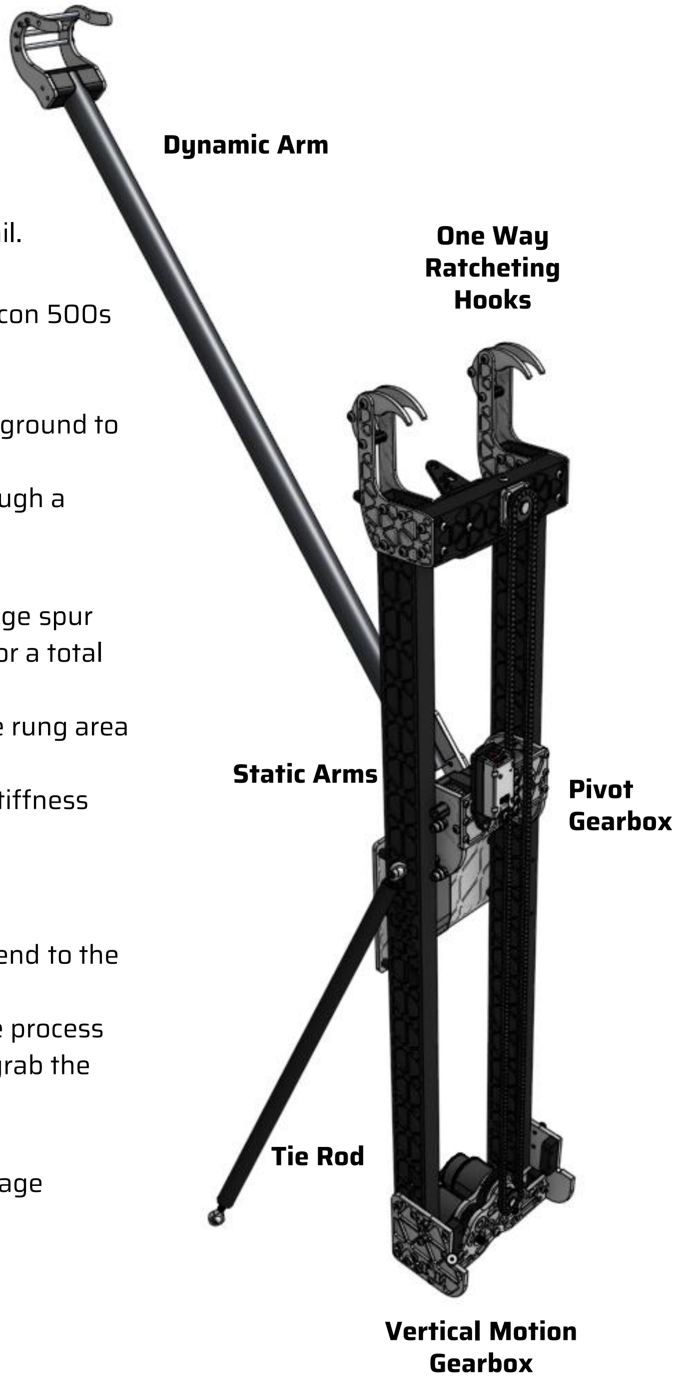
- ➢ Pivoted by a single Neo 550 with a single stage spur gear reduction and 2 stage versa planetary for a total reduction of 96.7:1
- ➢ Hooks have rubber standoffs overlapping the rung area to reduce swinging by increasing friction
- ➢ 1.25” OD round tube to maximize rotational stiffness

Static Arms

- ➢ Two 2”x1” ⅛ wall tubes mounted a custom gearbox/climber base.
- ➢ Strengthened by turnbuckle tie rods that extend to the outer chassis rails.
- ➢ One-way spring loaded hooks are used in the process of transferring the rung so the dynamic can grab the next.

Lift Carriage

- ➢ Uses bearings in 2 axes to constrain the carriage



PROGRAMMING

Field Centric Swerve Drive Control

- Movement is always relative to the driver station, not to the robot.
- Drivers can change rotational velocity independently of translational velocity
- Rotation of swerve modules is optimized to be at most 180 degrees. If initial calculations are more than 180 degrees, a coterminal angle is calculated to ensure faster module response times.
- Swerve modules are initialize to the “forward” position by saving desired starting position of each magnetic encoder in a file on the RoboRIO.

Autonomous Trajectory Generation and Path Following

- Robot follows a motion profile specifying velocity and acceleration at every time in the robot’s motion.
- This allows the robot to move in smooth spline curves throughout auto, enabling the most accurate and efficient movement.

Limelight Hub Turret Tracking

- Turret utilizes limelight camera to constantly track the hub.
- Drivers need only to press the shoot button to shoot, as the turret is always pointed towards the hub.

Turret Home Position Macros

- Drivers can move turret to one of 3 “home positions” with the simple press of a button.
- This allows drivers to spend less time on “micro” adjustments and more time on “macro” match strategy.

Automated Intake Control

- Intake is always “on” throughout a match. Different stages of the intake and feeder are turned off and on based on a variety of sensors without driver input.
  - State 1: Default state. Intake and feeder are both on
  - State 2: Transition to state 2 when photoelectric sensor indicates that feeder contains a cargo. Turn off feeder.
  - State 3: Transition to state 3 when running average of 20 current readings of the intake motor is greater than 25 amps. Turn off intake
- This automated control sequence ensures that drivers will never intake more than 2 cargo, and it removes complexity from their control duties.

PROGRAMMING

Flywheel PID Velocity Control

- Flywheel is kept at constant velocity through PID velocity control.
- Ensures that shots are consistent regardless of battery voltage

Motion Magic Motor Control

- Multiple subsystems including Drivetrain, Lift, and Turret are positinally controlled using in-built Motion Magic control.
- Motion Magic utilizes the internal speed controllers of each motor to bypass the RoboRIO 20ms update time.
- Positional and Velocity PID calculations are updated every 1ms instead of 20, allowing for more precise and accurate control of mechanisms.

Polymorphism Subsystem Class Structure

- Each subsystem inherits a parent “ValorSubsystem” class defining standard operational methods common to all subsystems.
- This allows subsystems to be treated as the same class type in TimedRobot methods such as RobotInit(), eliminating the potential for forgotten initialization or other common bugs.

State Machine Subsystem Control

- Each subsystem is initialized to a default state. The state can be changed by controller inputs in teleop or commands in auto.
- This allows for seamless control of subsystems between the teleop and autonomous periods and causes changes to subsystem behavior to occur globally across all files.